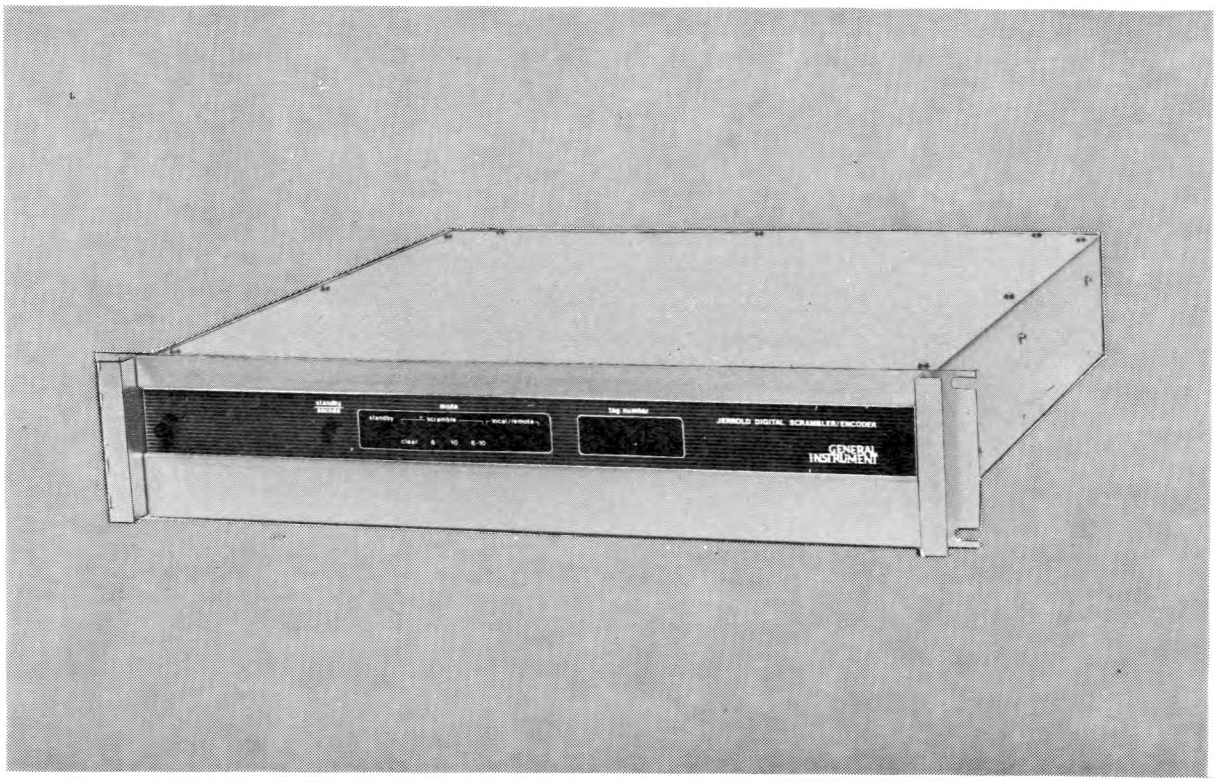
INSTALLATION MANUAL

435-949-00

Jerrold DIGITAL SCRAMBLER ENCODER MODEL DS/E



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GENERAL INSTRUMENT

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NOTE

This manual is identified by a three element part number on the front cover. Use this number for all correspondence regarding this manual. Subsequent right-hand pages identify only two elements of this number - the manual identifier (435) and the specific manual number (949). The third element identifies the original manual (00) or subsequent updates (01, 02, 03, etc.)

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1.0 INTRODUCTION

The Jerrold Model DS/E is a Digital Scrambler/Encoder which scrambles video information on a user selected non-addressable or addressable pay-TV channel in a CATV System. The scrambled channel is distributed throughout the system and also contains digital data which permits descrambling by authorized subscribers. Several different scrambling modes produce a signal which has a high degree of security, hence it is difficult to defeat and is essentially invulnerable to signal "pirating".

The DS/E is both forward and backward compatible with Jerrold in-band subscriber descramblers. The DS/E can produce signals which are compatible with existing Jerrold converters and can function as a replacement for the Jerrold Starpack Service Encoder, Model SSE-200AN Series II. It can also offer the more sophisticated scrambling codes when used with selected models of the Jerrold Digital 450 Model DRZD-* and other converter/descramblers (See Appendix A).

1.1 GENERAL

The DS/E scrambles signals using a multi-level sync suppression scheme. Three sync suppression levels can be pseudo-randomly switched by an algorithm within the DS/E making the level of each succeeding field unpredictable. Ten operator selected switching time intervals further complicate and discourage signal pirating.

Timing signals are transmitted as amplitude modulation (AM) on the audio carrier. These signals are used by a descrambler* to restore the original level to the sync pulses. A digital service code (TAG) also transmitted as AM modulation on the audio carrier enables the descrambler for authorized viewers. Scramble mode information, also transmitted on the audio carrier, provides the synchronization required for multi-mode descrambling.

The DS/E has the capability for adding baseband video encoding when used with a Jerrold Model DV/E Baseband Encoder. With the addition of the remote control option, the DS/E can be controlled by the Jerrold Model AH4 Addressable Control System.

*NOTE

The word "descrambler" in this manual means a converter/descrambler.

1.2 SPECIFICATIONS

Size: 19" wide, 3½" high, 17" deep.

Power Input: 110/120 Vac or 220/240 VAC 60Hz

Power Consumption: 20 watts at 117 VAC 60 Hz

Connectors:

Power Connection: 3 foot line cord

Inputs and Outputs Type "F" connectors

Temperature Range: + 15 °C to + 40 °C

Humidity: 5% to 95% relative

VIDEO

Input Level: .75V to 1.5V p-p. (nominal 1 V p-p NTSC Video Signal)

Impedance (input and output): 75 ohms

Polarity: negative sync

VIDEO IF

6 dB mode:	Sync 13 dB, video 7 dB.
10 dB mode:	Sync 17 dB, video 7 dB.
Clear mode:	Sync and video 0 dB ± .02 dB.
Standby mode:	Sync and video 10 dB ± .02 dB.

SOUND IF (DATA CHANNEL)

Signal type: Pulse amplitude modulation

Modulation: 6 dB + 0.5 dB, – 0.1 dB.

Insertion loss: less than 1 dB

Impedance (input and output): 75 ohms

1.3 FRONT PANEL DISPLAYS

Seven LED indicators, visible through a window in the front panel, give a continuous indication of the status of the DS/E. These LEDs indicate the scrambling mode and the operating control source which will be either LOCAL or REMOTE.

A three digit number, also visible through a window in the front panel, indicates the service code currently being transmitted.

1.4 FRONT PANEL CONTROLS

Two ¼ turn captivated thumb screws, one on each side of the front panel, can be turned to release the front panel which pulls out, but not off, and then hinges down. This procedure exposes seven operator controls (see Figure 1-1) which are identified on the rear of the fold down front panel.

Viewed facing the front of the panel these controls are:

SWITCHING TIME thumbwheel switch
SERVICE CODE SET thumbwheel switches
SCRAMBLE MODE pushbutton switch
REMOTE/LOCAL toggle switch
STANDBY pushbutton switch
AC POWER rocker switch
VIDEO DELAY and AUDIO DELAY thumbwheel switches

In addition to the controls and displays the front panel has three terminals providing access to the HOR. SYNC, VERT. SYNC, and GROUND.

1.5 REMOTE CONTROL OPTION

With the REMOTE/LOCAL toggle switch in the REMOTE position the front panel controls (with the exception of the timing adjustments) are disabled. Control is passed to the Addressable Control System Computer when the remote control option is installed. With this option installed each DS/E is individually addressable and under the control of the Addressable Control System.

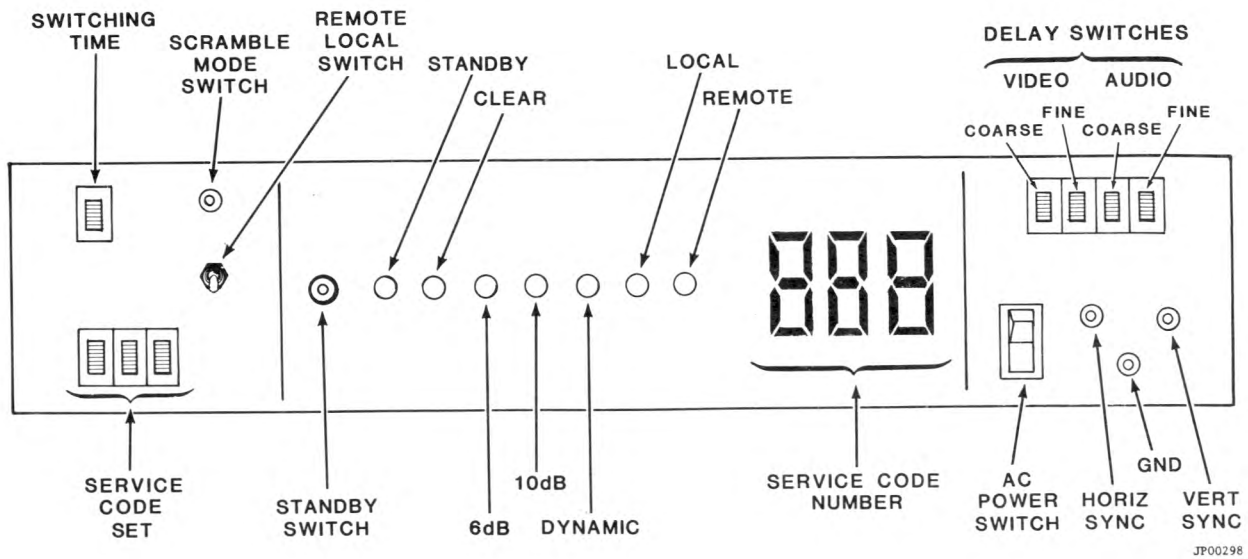


FIGURE 1-1. FRONT PANEL CONTROLS AND INDICATORS

1.6 SYNC STRIPPER

The sync stripper samples the sync pulses on the video signal and delivers these pulses to the timing pulse generator. A 4.5 MHz filter is included along with the sync stripper to reduce cross coupling between video and audio. This filter is connected with an external jumper and, at the option of the user, can be eliminated and replaced with a filter of the user's choice (See Figure 1-2).

1.7 DATA MODULATOR

Timing signals are supplied to the data modulator from the video delay and data generator together with digital data containing the authorization service code. These signals are amplitude modulated on the audio IF signal. An AM receiver in the descrambler detects these signals. The detected timing signals provide the converter/descrambler with the information needed to restore the sync pulses to their original amplitude. The detected service code is compared to the "authorized service" list within the descrambler to restore the video.

1.8 VARIOLOSSER

The variolosser, controlled by signals from the video delay module, suppresses the sync pulses at the video IF. The sync is suppressed by 0, or 6 or 10 dB.

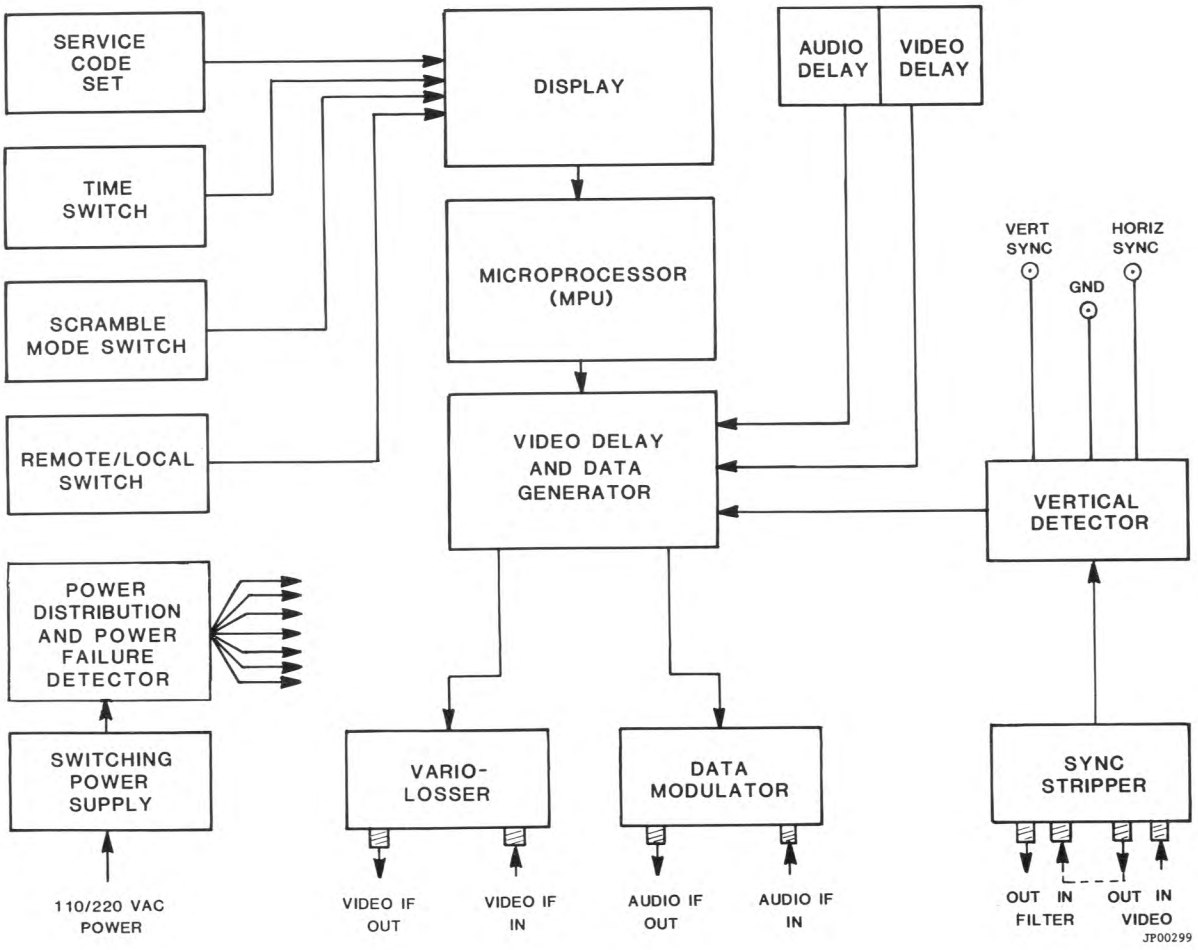


FIGURE 1-2. DS/E FUNCTIONAL BLOCK DIAGRAM

2.0 INSTALLATION AND CALIBRATION

2.1 EQUIPMENT REQUIREMENTS

In addition to the DS/E scrambler and mounting screws this installation procedure requires equipment to calibrate and adjust the in-band timing of the DS/E. Two procedures are described for making the in-band timing adjustments. Each procedure requires a different complement of test equipment. In most cases the choice of which procedure to use will be dictated by the availability of equipment. Equipments required for procedure I and II are as indicated in Table 2.1.

2.2 PRE-INSTALLATION CHECKS

The DS/E is shipped from the factory ready to operate from a 115 VAC 60 Hz power source in all scrambling modes. At the time of installation the DS/E can be changed to accommodate either one or both of two configurations.

A. 220 VAC source operation

B. SSE-200AN scrambler only (6 dB) operation.

If an installation other than the original installation is planned or if the unit is to be operated from a 220 VAC source then the DS/E configuration for each option should be visually checked.

CAUTION
REMOVE POWER BEFORE MAKING ANY CONFIGURATION CHANGES.

To check or to change the configuration remove the screws fastening the top cover and remove the cover. Replace the cover and all screws when the check or change is completed.

2.3 THE 220 VAC CONFIGURATION

1. Observe at the rear of the unit the switching power supply with a jumper as shown in Figure 2-1.
2. Remove the jumper for 220 VAC operation.

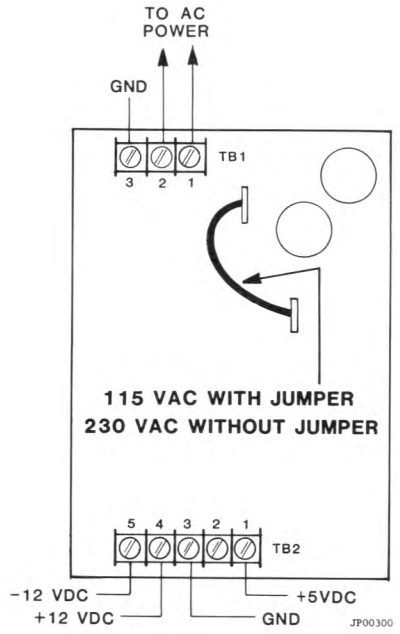
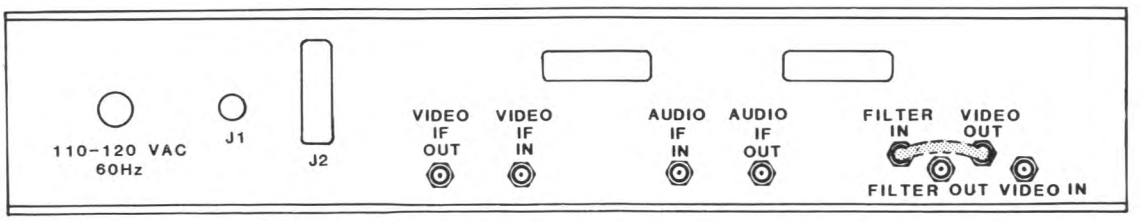


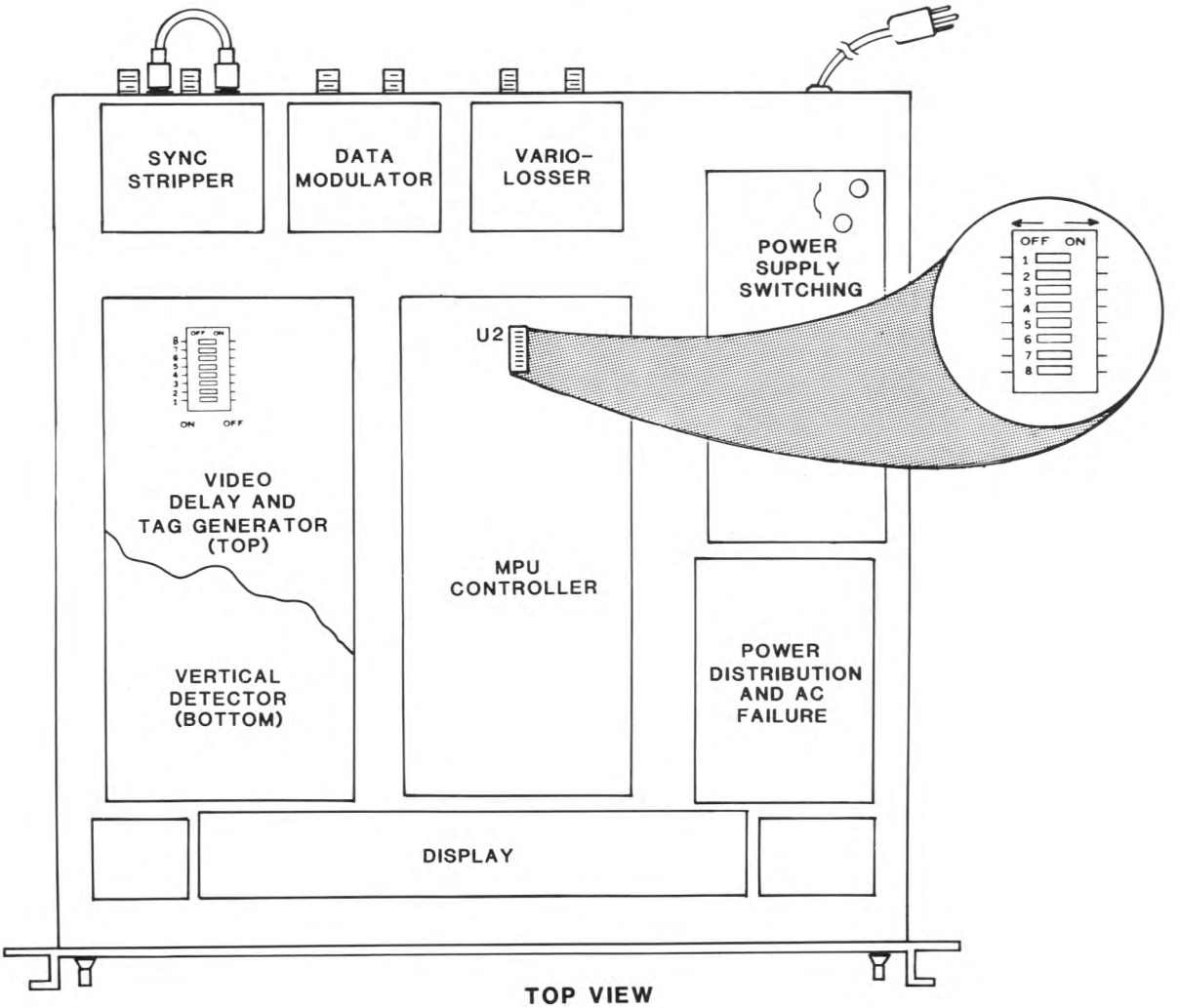
FIGURE 2-1. POWER SUPPLY CONNECTIONS

TABLE 2.1 CALIBRATION TEST EQUIPMENT

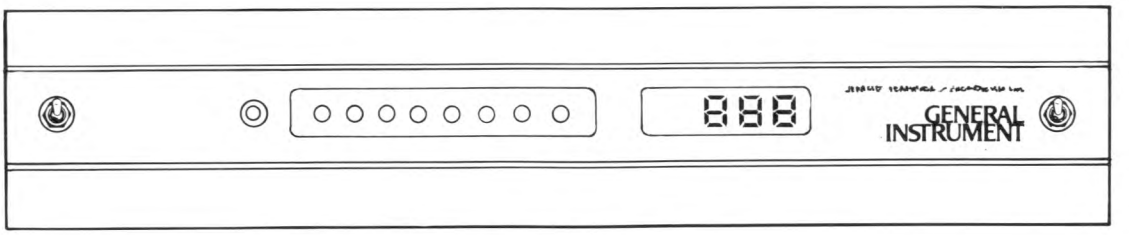
Item	Description	Procedure	
		I	II
1	Jerrold Commander IV modulator (or equivalent)	X	X
2	75 ohm coaxial cable assemblies of suitable length (5 required)	X	X
3	75 ohm dummy load	X	X
4	Tektronix Model 7600 mainframe (or equivalent)	X	
5	Tektronix Model 7L12 Spectrum Analizer (or equivalent)	X	
6	Tektronix Model 7A18 Dual Trace Amp.	X	
7	Tektronix Model 7B53A Dual Time Base	X	X
8	NTSC Signal Generator or Video Source	X	X
9	TV monitor with demodulator output		X
10	Calibrated Reference Converter (Jerrold Model DSX-DS)		X
11	Variable attenuator	X	X
12	Converter/Descrambler (Jerrold DSZD-*)		X
13	10 MHz Oscilloscope		X



REAR VIEW



TOP VIEW



FRONT PANEL

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FIGURE 2-2. DS/E FRONT, TOP, AND REAR VIEWS

2.4 THE SSE-200AN ONLY CONFIGURATION

1. Observe at the rear or the Microprocessor Unit (MPU) eight miniature switches mounted on a 16 pin DIP. (See Figure 2-2) These two position switches are numbered from 1 through 8 counting from the back to the front of the DS/E. Switch number 7 effects the scrambler mode as follows:

   Switch 7 ON - SSE-200AN emulation (6 dB only, service codes 1-128 only).

   Switch 7 OFF - Standard DS/E operation.

   NOTE

   Do not disturb the position of any of the other switches on the DIP socket.

2.5 INSTALLATION OPTIONS

In addition to the AC power source and the SSE-200AN emulation configurations there are options which enhance the capabilities of the DS/E. Installation instructions for the following options are not covered in this manual:

A. Operating the DS/E remotely from an Addressable Control System. This option requires an AH-4 Addressable System and the remote control option.

B. Operating the DS/E into a RF modulator other than a Jerrold Commander 4 series or equivalent.

C. Operating the DS/E with a baseband video encoder (DVE).

2.6 CABLE SYSTEM CONSIDERATION

Many Jerrold converter/descramblers are capable of handling only the 6 dB sync suppression scrambling. For non-addressable converter/descramblers the service code is limited to 1 through 8. For early addressable converter/descramblers it is limited to 1 to 128. Later Jerrold models can handle the full range of scrambling modes from the DS/E along with valid service codes from 1 through 256. To avoid possible misuse in operating the DS/E it is recommended that consideration be given to the system configuration and to this feature of converters in deciding whether the DS/E should be configured for the SSE-200AN emulation mode. Appendix A lists the model designation, the descrambling capability, and the service code range for several Jerrold Converter/Descramblers.

2.7 MOUNTING

Mount the DS/E in a standard 19 inch rack preferably adjacent to and in the same rack as the modulator with which it is to be used. The best performance can be expected when the cables connecting the DS/E to its modulator are short. Fasten the unit in place with the four front panel mounting screws furnished with each unit.

2.8 ELECTRICAL CONNECTIONS

1. Connect the 75 ohm coaxial cables to the DS/E scrambler and modulator as detailed in Figure 2-3.
2. Terminate the video signal which is to be scrambled into a 75 ohm dummy load and confirm that the peak-to-peak voltage on this signal is not less than .75 volt and not greater than 1.5 volt using the oscilloscope. Adjust this level to 1 V p-p if necessary at the source.
3. Connect the video signal from the 75 ohm source to the video input connector on the DS/E.
4. Plug the line cord into the nearest availble AC power outlet within the rack.

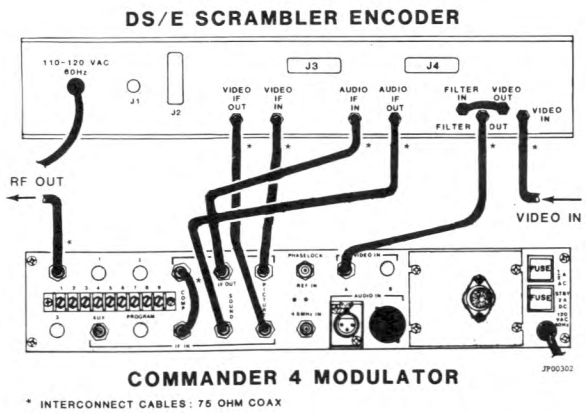


FIGURE 2-3. ELECTRICAL CONNECTIONS

2.9 OPERATING CHECK

After an installation has been satisfactorily completed the operating controls and indicators should be checked to confirm performance. Before proceeding with this check remove the cable connecting the modulator output to the cable system and terminate it in a 75 ohm load (Jerrold TR-75V).

Turn the front panel retaining screws to release the front panel and expose all operating controls. Power the modulator and perform the following:

1. Turn the DS/E on by moving the power switch to its ON position.

2. Move the LOCAL/REMOTE toggle switch to its LOCAL position. In the REMOTE position all front panel operating controls are disabled. Observe the LOCAL LED comes ON.

3. Move each of the three thumbwheel switches in the lower left hand corner labeled SERVICE CODE SET to any number between 001 and 256 (001 to 128 if configured as SSE-200AN). Observe on the digital display the same number to which the thumbwheels are set. Position the three thumbwheel switches to any number higher than 256 (128 if configured for SSE-200AN) and observe on the display three blinking dashes. Service codes larger than 256 are invalid and the blinking dashes indicate this error. Observe also that when the blinking dashes are on the display the STANDBY mode indicator also comes ON. This feature automatically prohibits the transmission of an invalid service code to a subscriber terminal. When a valid service code (any number from 1 through 256) is entered the blinking stops and the code is displayed. When the DS/E is configured to operate as an SSE-200AN the valid service codes are restricted to number 1 through 128.

NOTE

Using service codes 129 through 137 is not recommended. Jerrold converter/descramblers with a DIC suffix will recognize these service codes as 1 through 8. This is because the second group of 128 codes on the DS/E are identical to the first group except for the high order bit which the DIC device does not read.

4. Press and release the STANDBY switch and observe the LED indicators. The DS/E will go to the STANDBY mode if it was not in that mode or the DS/E will return to the scrambling mode in use immediately prior to the last time the STANDBY switch was pressed. The STANDBY switch functions regardless of the position of the LOCAL/REMOTE toggle switch.

5. If the STANDBY indicator is ON, press and release the STANDBY switch to put the DS/E into one of the four scrambling modes. Alternately press and release the SCRAMBLE MODE push button and observe that the scrambling mode increments stepping from left to right in a repeating fashion as CLEAR, 6 dB, 10 dB, DYNAMIC, CLEAR, etc.

NOTE

The SCRAMBLE MODE switch is inactive if the LOCAL/REMOTE toggle switch is in the REMOTE Position or if the DS/E is configured for the SSE-200AN emulation (6 dB only mode).

2.10 DYNAMIC MODE

In the Dynamic Mode the sync suppression is switched between 0, 6 and 10 dB with seven different switching time intervals.

The ten position SWITCHING TIME thumbwheel selects the switching time interval. This interval for each of the SWITCHING TIME switch positions are shown in Table 2.2.

TABLE 2.2 DYNAMIC MODE SWITCHING AND CODE OPTIONS

Timing Switch Position	Switching Time Interval*
0	15 SECONDS
1	30 SECONDS
2	1 MINUTE
3	0.25 SECONDS
4	3 SECONDS
5*	0.25 SECONDS
6*	3 SECONDS
7*	15 SECONDS
8**	0.25 SECONDS
9**	3 SECONDS

* Clear/6/10 pseudo random as:C/C/6/10/6/6/C/10/C/6/10/10 - - -

** Clear/10 pseudo random as: C/10/10/C/10C/C/C/10/C/ - - -

2.11 CALIBRATION REQUIREMENTS

Satisfactory performance of the DS/E requires that data pulses and timing signals occur at specific times relative to the video sync pulses. The video signal passing through the modulator experiences time delays which can vary for different modulators. The timing and data pulses originating in the DS/E therefore require time delay adjustments to compensate for the delay in the modulator. The purpose of the calibration procedure is to adjust these time delays.

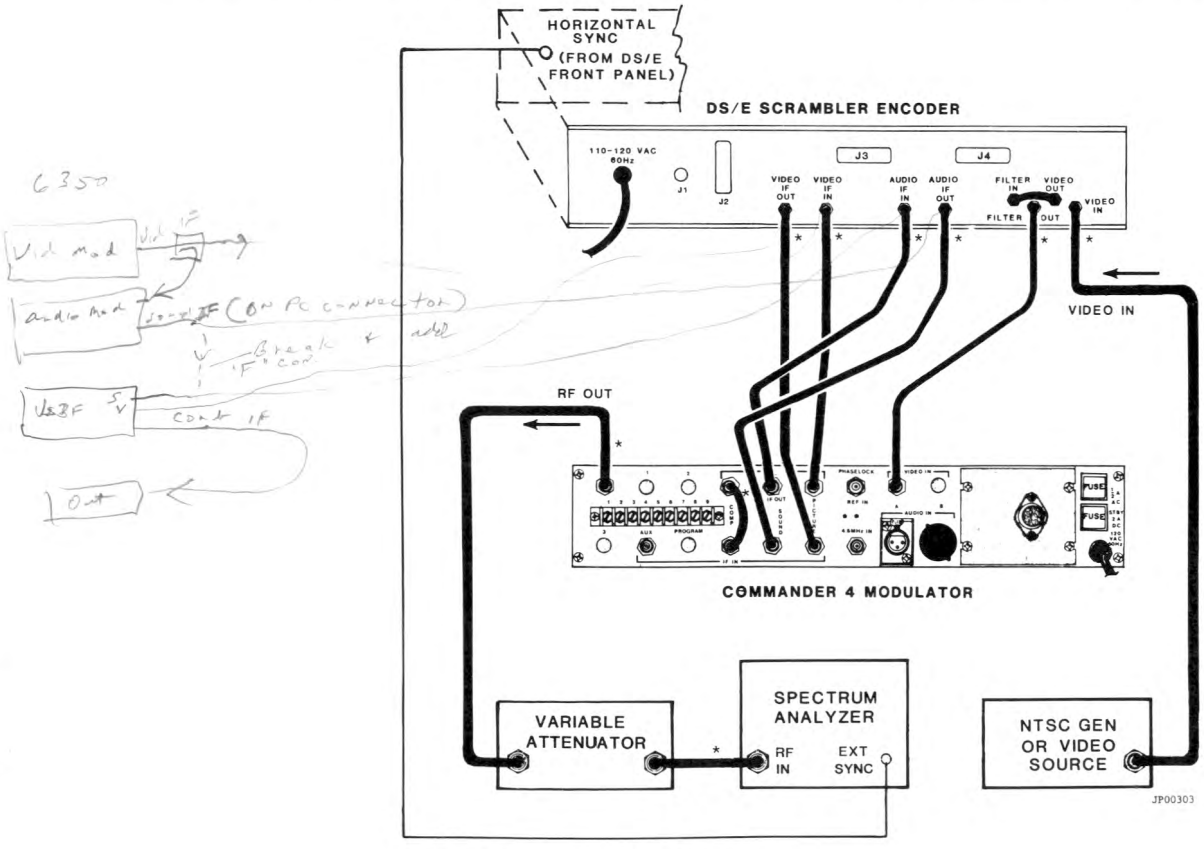
The Delay Switches (see Figure 1-1) provide the means to adjust the time delays. Each thumbwheel switch has 16 positions that increment as follows:

SWITCH	INCREMENTS
Coarse Video	1.12 microseconds
Fine Video	70 nanoseconds
Coarse Audio	1.12 microseconds
Fine Audio	70 nanoseconds

Connect the calibration equipment to the DS/E and modulator as shown in Figure 2-4.

2.12 PROCEDURE I IN-BAND TIMING BY THE RF METHOD

1. Apply power to all units.
2. Set the DS/E to "STANDBY". Using the Spectrum Analyzer or Field Strength Meter, set the sound carrier to a level 15 dB below the picture carrier. The RF output of the modulator may be set to any arbitrary level. Set the NTSC Generator to FLAT FIELD, 0 APL.
3. On the DS/E set the LOCAL/REMOTE switch to LOCAL and the SCRAMBLE MODE to "6 dB".
4. Set up the Model 7600 Spectrum Analyzer as follows:
   a. Plug 7L12 into the two left slots
   b. Plug 7B53A into the right slot
   c. Set the 7600 Mainframe controls as follows:
      - Vertical mode - LEFT
      - Trigger mode - RIGHT



*INTERCONNECT CABLES: 75 OHM COAX

FIGURE 2-4. CALIBRATION BENCH SETUP/PROCEDURE I

2.12 Continued

d. Set the 7B53A controls as follows:
   - EXTERNAL SYNC
   - AC COUPLED
   - AUTO MODE

e. Set the 7L12 controls as follows:
   - Mode - NORM
   - Source - INT
   - Resolution - 3 MHz
   - Scan - 10 MHz
   - 10 dB/DIV or LOG

5. Set the RF output of the modulator to any arbitrary level which provides a clear display on the spectrum analyzer.
6. Tune the analyzer to the video carrier of the scrambled channel. Set the 7B53A time base to 50 microseconds per division. Set the analyzer amplitude display to LINEAR. Check to see that the analyzer is "peaked-up" on the carrier. The RF level may have to be varied in order to keep the waveform on the display. See Figure 2-5.
7. Expand the delay time to 2 microseconds per division. Adjust the coarse and fine VIDEO DELAY thumbwheels so that the "front porch and leading guard band" interval is 2 microseconds. Adjust the DIP switchpack on the Video Display and Tag Generator so that the overall pulse width, as in Figures 2-6 and 2-7, is 12 microseconds. The DIP switches adjust in a binary fashion with switch #1 LSB and switch #8 MSB.
8. Expand the delay time to 500 nanoseconds per division and position the pulse so that the falling edge begins to switch on the center vertical line of the graticule. This center line is the SCRAMBLE REFERENCE. See figure 2-8.
9. Tune to the sound carrier of the scrambled channel. Make sure that the horizontal reference setting is not disturbed in any way. If no pulse appears on the display, adjust the coarse and fine AUDIO DELAY thumbwheels until a pluse becomes visible. Make sure that the analyzer is "peaked-up" on the signal. See Figure 2-9.
10. Set the variable attenuator for 2.5 dB of attenuation and position the pulse so that the peak is on the center horizontal line of the graticule. This horizontal line is the DE-SCRAMBLE REFERENCE. See Figure 2-10.
11. Remove the 2.5 dB of attenuation and adjust the coarse and fine AUDIO DELAY thumbwheels so that the pulse crosses the DE-SCRAMBLE REFERENCE 700 nanoseconds before the SCRAMBLE REFERENCE. See Figure 2-11.
12. Set the 7B53A time base to 50 microseconds per division. Observe on the CRT screen 2 microsecond wide pulses at 63 microsecond intervals (no timing pulses during the vertical interval). The start bit appears 20 microseconds to the right of the first timing pulse after the vertical interval. See Figure 2-12.
13. Connect the RF output of the modulator to the CATV headend and adjust the output level to system specifications.
14. This completes the Timing adjustment for Procedure I.

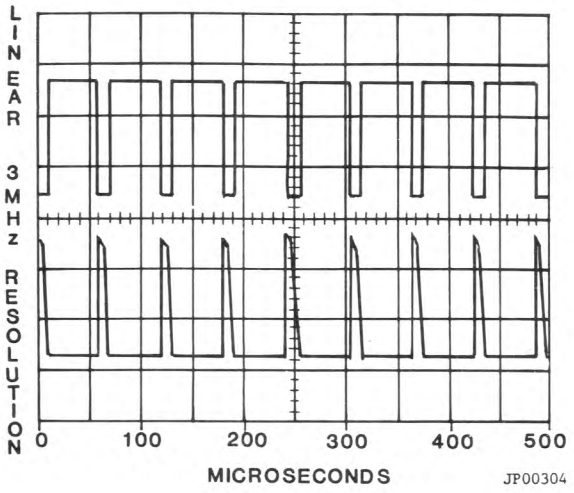


FIGURE 2-5. OSCILLOSCOPE DISPLAY

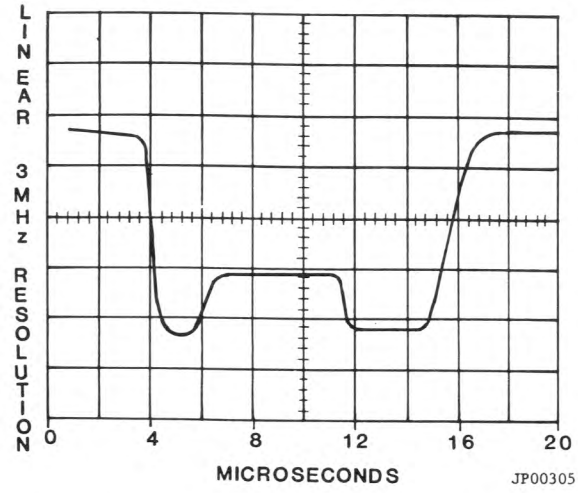


FIGURE 2-6. OSCILLOSCOPE DISPLAY

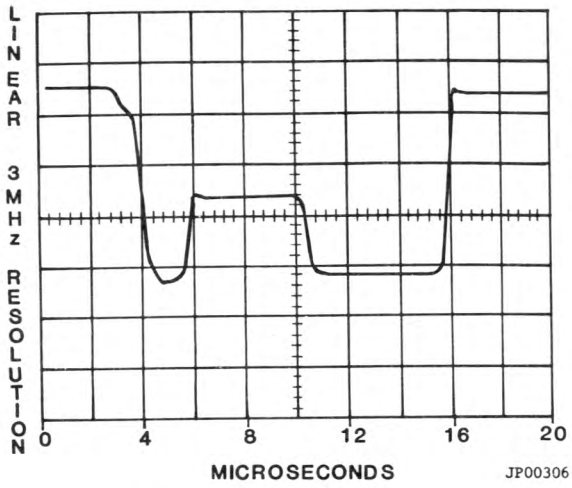


FIGURE 2-7. OSCILLOSCOPE DISPLAY

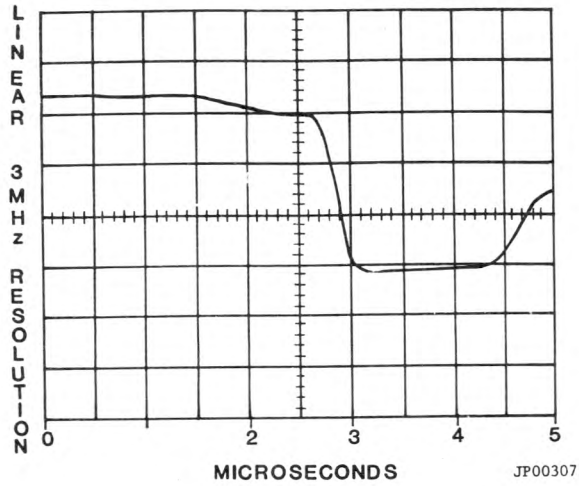


FIGURE 2-8. OSCILLOSCOPE DISPLAY

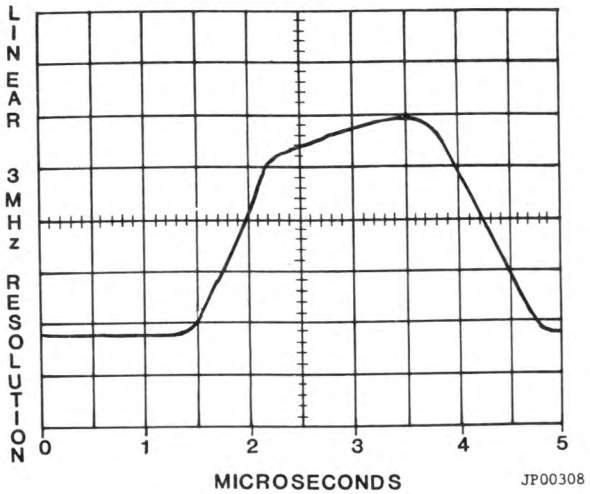


FIGURE 2-9. OSCILLOSCOPE DISPLAY

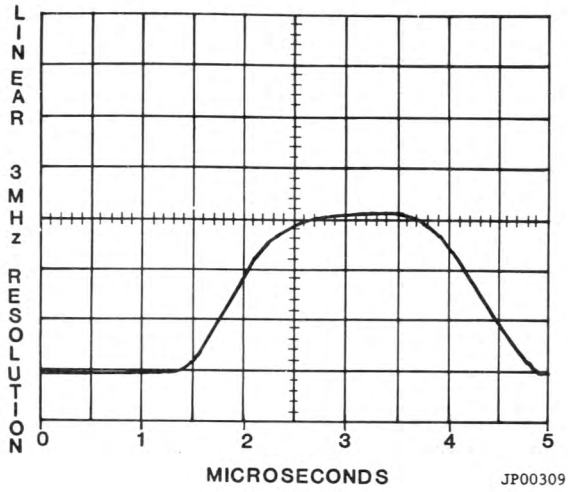


FIGURE 2-10. OSCILLOSCOPE DISPLAY

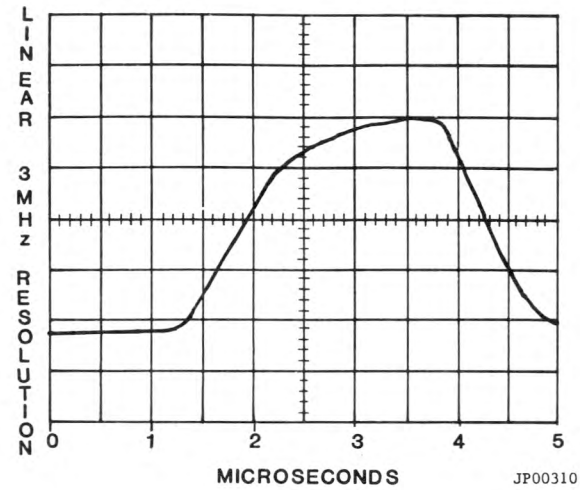


FIGURE 2-11 OSCILLOSCOPE DISPLAY

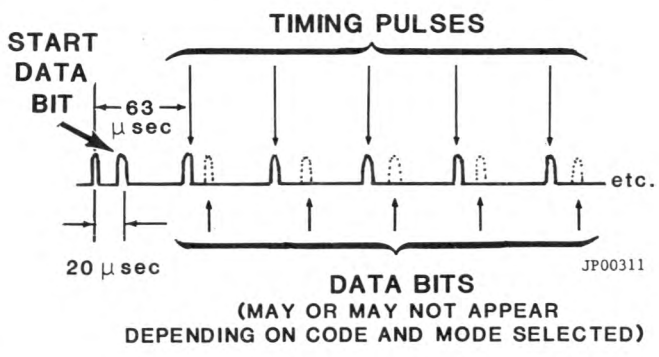
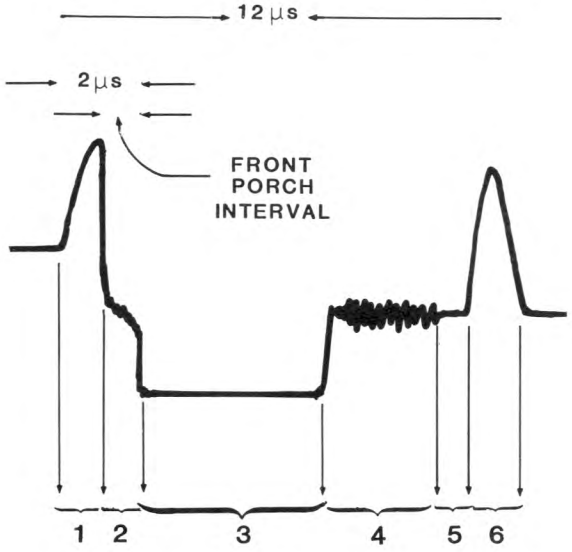


FIGURE 2-12. OSCILLOSCOPE DISPLAY

2.13 PROCEDURE II. IN-BAND TIMING BY THE CALIBRATED REFERENCE CONVERTER METHOD

This procedure uses the Jerrold Model DSX-DC calibrated reference converter. This unit is a DIC-type converter which has been calibrated at the factory and programmed to descramble levels 1 through 128.

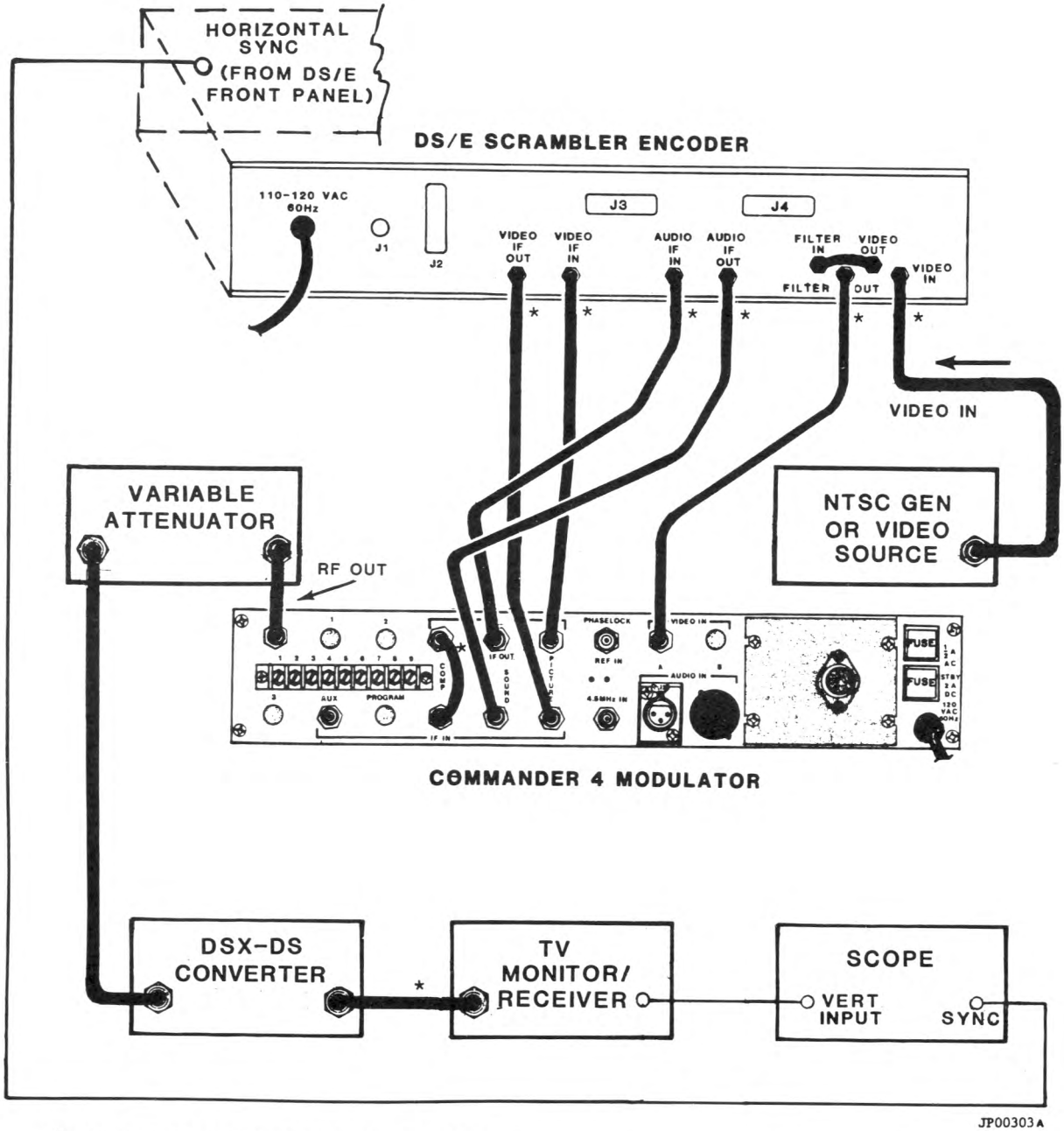
1. Apply power to all units.
2. Set the DS/E to "STANDBY". Using a spectrum analyzer or field strength meter, set the sound carrier level 15 dB below the picture carrier. The RF output of the modulator may be set to any arbitrary level.
3. Interconnect the test equipment as shown in Figure 2-14. If an NTSC generator is available, set it for flat field and 0 APL. Connect the oscilloscope external trigger to the horizontal sync pin on the front panel of the DS/E.
4. Adjust the attenuator to provide +5 dBmV (video carrier level) input to the DSX-DS. Verify this level by connecting a signal level meter to the output of the attenuator.
5. Set the DS/E to "SCRAMBLE - 6 dB" and select a service code between 1 and 128. The waveform should resemble that shown in Figure 2-13. If the waveform does not conform, the timing must be adjusted.
6. Adjust the timing as follows:
   a) Adjust the AUDIO DELAY thumbwheel switches until the front porch interval is equal to the value specified on the calibration sticker on top of the DSX-DC. The coarse delay thumbwheel will adjust this in 1.12 microsecond intervals; the fine delay thumbwheel in 70 nanosecond intervals.
   b) Adjust the VIDEO DELAY thumbwheel switches to obtain 2 microseconds from the rising edge of the leading guard band to the falling edge of sync. The coarse delay thumbwheel will adjust this in 1.12 microsecond intervals; the fine delay thumbwheel in 70 nanosecond intervals.
   c) Adjust the DIP switch pack on the VIDEO DELAY board so that the OVERALL PULSE WIDTH is 12 microseconds. This interval will increase in 70 nanosecond steps as the switches are incremented in a binary fashion (switch #8 = MSB/ switch #1 = LSB).
7. This completes the timing adjustment for Procedure II.



1- LEADING GUARD BAND
2- FRONT PORCH
3- SYNC PULSE
4- COLOR BURST
5- BACK PORCH
6- TRAILING GUARD BAND

JP00411

FIGURE 2-13. DESCRAMBLED VIDEO WAVEFORMS



*INTERCONNECT CABLES: 75 OHM COAX

FIGURE 2-14. CALIBRATION BENCH SETUP/PROCEDURE II

APPENDIX A

Descrambler Mode capability and service code range for Jerrold Converter/Descramblers.

Model	Descrambler Mode	Service Code Range
JSM-*DIC	6dB	1 to 8
JSX-*DIC	6dB	1 to 8
JRX-*DIC	6dB	1 to 8
DSX-*DIC	6dB	1 to 8
DSXR-*DIC	6dB	1 to 8
DRX-*DIC	6dB	1 to 8
DSZ-*DIC	6dB	1 to 8
DRZ-*DIC	6dB	1 to 8
SB	6dB	1 to 8
SB-*-200	6dB	1 to 8
SBD	6/10 dB/CLEAR	1 to 8
DRZD-*DIC	6/10 dB/CLEAR	1 to 8
JSX-*A	6dB	1 to 128
JRX-*A	6dB	1 to 128
DSX-*A	6dB	1 to 128
DX-*A	6dB	1 to 128
DRX-*A	6dB	1 to 128
DSZ-*A	6dB	1 to 128
DRZ-*A	6dB	1 to 128
DSZP-*A	6dB	1 to 128
DRZP-*A	6dB	1 to 128
SB-*A	6dB	1 to 128
DRZD-*A	6/10 dB/CLEAR	2 to 128
SBD-*A	6/10 dB/CLEAR	2 to 128
XT-3-***	6/10 dB/CLEAR (VIDEO INV)	1 to 256

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